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Field screening of RRISL recommended rubber clones against Corynespora Leaf Fall Disease

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Abstract

Identification of resistant clones is of vital importance in the management of Corynespora leaf fall disease (CLFD) of rubber. The recommended and potential clones were screened in a bud wood nursery which was especially designed for screening purposes at Ratnapura, Kalutara, Moneragala and Padiyatalawa. The lesion types agreed with the symptoms observed in the field plants and new symptoms have been identified from Padiyatalawa, in non-traditional rubber growing areas. Analysis of results from test methods showed that 81% of the recommended clones by the Rubber Research Institute of Sri Lanka (RRISL) can be ranked as resistant. Among the clones screened, no clones were found to be severely susceptible, yet moderately or mildly susceptible clones have been identified. This information should be used in future breeding programmes and also should be considered by the growers while selecting clones for their own plantations. The cultivation of resistant clones with a wide genetic base is considered as the most reliable long-term solution in the management of CLFD.

***Key words*:** clonal screening, *Corynespora cassiicola, Hevea brasiliensis*

Introduction

Natural rubber is an important commodity to the economy of Sri Lanka in export earnings, providing livelihood to over thousands of people, supplementing thousands of hectares to the forest cover and providing many other socio-economic and ecological benefits. Corynespora leaf fall disease (CLFD) caused by *Corynespora cassiicola*, is a malady with relatively recent origin and has caused several global epidemics (Tan *et al*., 1992; Soepena, 1983; Kajornchaiakul, 1987; Rajalakshmi and Kothandaraman, 1996; Jayasinghe, 2003; Fernando *et al.*, 2009; Dung & Hoan, 1999; Jean, 2000 and Begho, 2000). CLFD causes extensive damages to both immature and mature trees and the pathogen produces numerous types of lesions with characteristic blighted leaves followed by leaf fall. Repeated defoliation results in die-back of shoots and branches retarding growth, extending the period of immaturity and sometimes leading the plant to death (Edathil *et al.*, 2000; Jayasinghe *et al.*, 2005; Jacob, 1997). Sri

Lankan rubber growers experienced the first CLFD epidemic in 1985/86 period. One of the prestigious clones bred by the Sri Lankan scientists, RRIC 103 succumbed to this disease. At that time, the stakeholders were offered three options; to replace susceptible clones with resistant clones, base budding and crown budding. Among the options, uprooting the susceptible clones and replacing with the resistant clones became popular among the growers (Liyanage *et al.,* 1989). The second epidemic was in mid 1990s and devastated another prestigious clone, RRIC 110. During the recent past more than a dozen of potential clones were withdrawn from experimental sites as they became highly susceptible to the disease.

Since, 1980s screening of clones for foliar diseases, especially CLFD has played an important role in disease management. Because of this effort, our growers today enjoy CLFD free rubber plantations in spite of the fact that Sri Lanka was one of the worst affected countries during the past. The reason has been the selection of clones though intensive screening during the breeding programmes. During the past many methods have been investigated for disease screening purposes. Among them screening of clones in a bud wood nursery which was specially designed for screening purposes was proven to be effective (Fernando *et al.,* 2011). To compare the observations, clones have been selected from field clearings and they have been screened under natural conditions. This paper reports the results of clonal screening programmes against Corynespora leaf fall disease during 2014 - 2016 to identify CLFD resistant clones using the above mentioned methods.

Methodology

Screening of the clones in a bud wood nursery

Bud wood nursery experiments were established at the RRISL sub-stations in Ratnapura and Monaragala. The experimental plots consisted of 50 test clones, (recommended by RRISL and clones under consideration for recommendation). The susceptible clones (like RRISL 201 & RRISL 202) were planted randomly to release the necessary inocula to the test plants. The site selected was also adjacent to the fields with CLFD susceptible clones *viz*. RRIC 110, RRISL 202, RRISL 201 thus ensuring the continued exposure of test plants to natural inocula. The test clones were inspected for the incidence of CLFD for three consecutive years, from 2014 to 2016 using five plants per clone. A score was given to clones based on visual observations.

Screening of the clones under field conditions

Mature field clearings were selected from estates/RRISL collaborative trials, small scale and large scale plantings to include 41 clones (given below) recommended by RRISL. All clones were screened annually at 12 locations for three consecutive years (2014-2016).

Clones tested under field conditions

The following clones were tested under field conditions; *viz.* RRIC 100, RRIC 102, RRIC 121, RRIC 130, PB 217, PB 28/59, RRIC 117, RRIC 133, RRISL 201, RRISL 202, RRISL 203, RRISL 205, RRISL 206, RRISL 211, RRISL 215, RRISL 217, PB235, PB260, MPB24, RRISL 200, RRISL 208, RRISL 218, RRISL 220, RRISL 221, RRISL 222, RRISL 226, GPS 1, PB 255, PR 255, RRII 105, RRISL 2001, RRISL 2003, RRISL 2000, RRISL 2002, RRISL 2004, RRISL 2005, RRISL 2006, Cent 2, Cent 3, Cent 4 and Cent 5.

Sampling techniques

Eight randomly selected plants from each clearing and another five plants from every 100 trees of the clearing were examined. To select the test plants randomly, each field was divided into four quadrants. The test plants were selected along the directions randomly as given in the Figure 1. Four shoots were randomly removed from each canopy of each test plant. The number of leaves having lesions were counted and recorded as a percentage. Percentage of the fallen leaves was also assessed visually.

Assessment of disease severity

A scoring system adopted by Jayasinghe *et al*. (2004) which is given below was used for assessing the disease incidence and the severity.

Index for scoring of disease severity	Description
0	Highly resistant clones under field conditions. No symptoms on any of the leaves
1	Clones having few (less than 25%) leaves of the canopy with CLFD symptoms and no detectable defoliation due to CLFD (Light infections)
2	Clones having few (less than 25%) leaves of the canopies with CLF symptoms and up to 25% defoliation of the canopies due to CLFD (Moderate infections)
3	Clones having more than 25% of the leaves with symptoms and 26–75% defoliation due to CLF (Severe infections)
4	Clones having more than 75% defoliation due to CLFD (Very severe)

Development of average disease severity index (ADSI)

ADSI was calculated using following formula adopted by Jayasinghe *et al.*, (2004).

$$ADSI = \frac{[(0 * n1) + (1 * n2) + (2 * n3) + (3 * n4) + (4 * n5)]}{N}$$

where,

n1 = No. of plants representing score index 0

n2 = No. of plants representing score index 1
n3 = No. of plants representing score index 2
n4 = No. of plants representing score index 3
n5 = No. of plants representing score index 4

Ranking of clones

Ranking was carried out based on the average disease severity index as follows.

ADSI value	Description
0	No disease (Resistant)
0.01 - 1.00	Light infections (Mild)
1.01 - 2.00	Moderate infections (Moderate)
2.01 - 3.00	Severe infections (Severe)
3.01 - 4.00	Very severe infections (Very severe)

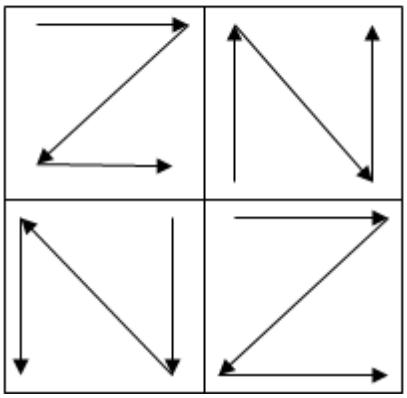

Fig. 1. The directions of selection of test plants in quadrants

Results and Discussion

Management of CLFD using resistant clonal material is the strategy for preventing epidemics of *C. cassiicola* that has been adopted in many rubber growing countries (Fernando *et al.*, 2010; Jayasinghe *et al.*, 2005, Situmorang & Budiman, 1984; Kajornchaiakul, 1987). There is a marked variation in the clonal susceptibility to CLFD and all the rubber growing countries have therefore prepared susceptible/resistant clone lists using different screening technologies (Kumar & Hidir, 1996; Dung & Hoan, 1999; Idicula *et al.*, 2000; Sujatno & Suhendry, 2000 and Fernando *et al.*, 2010).

The results taken annually in the bud wood nursery experiments are shown in Table 1. Screening of the major clones grown under field conditions are given in Table 2. The lesion type produced by these clones in the bud wood nursery experiments agreed with the symptoms produced by the field plants. Further, analysis of the results from the screening under natural field levels shows that 81% of the clones in RRISL recommendation list are free from CLFD and can be ranked as resistant. 10% of the clones showed mild infections, 3% moderate infections and 6% of the clones showed severe infections (Fig. 2). The highly susceptible clones have already been removed from the list of recommendation. The clones which showed mild infections too have been downgraded and are under constant observation.

Screening of clones under bud wood nursery conditions has shown to be comparatively rapid (Fernando *et al.*, 2010). With the observations from screening under field conditions, the

results become more reliable. Some clones showed variable responses to the disease in different years due to the effect of pre disposing factors such as inoculum potential and weather conditions (Fernando *et al.*, 2011). It is expected that these results will be helpful in future planting programmes and also in future breeding programmes.

The cultivation of resistant clones with a wide genetic base is considered as the long term and most reliable solution for the management of CLFD in all the rubber growing countries including Sri Lanka. Furthermore, the selection or grouping into categories will ease the selection of resistant germplasm to be used in the conventional crossing programmes.

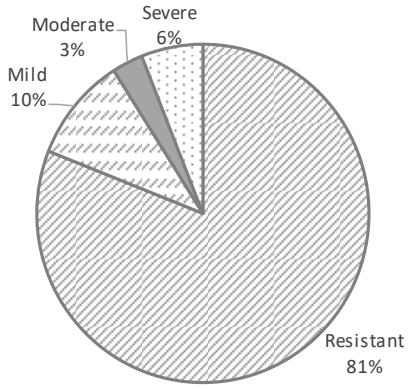

Fig. 2. Ranking of RRISL recommended clones for the susceptibility CLFD based on the clonal screening programmes

Table 1. *Mean Disease incidences of the clones established in the bud wood nursery experiments at Ratnapura and Moneragala*

Clone	Average disease severity score			Mean ADSI
	Year 2014	Year 2015	Year 2016	
RRISL 211	2	1	1	1.33
RRISL 219	0	0	0	0
RRISL 200	2	4	3	3
PB 255	0	0	0	0
RRIC 117	1	0	1	0.66
RRISL 206	0	0	0	0
RRISL 2006	0	0	0	0

Clone	Average disease severity score			Mean ADSI
	Year 2014	Year 2015	Year 2016	
RRIC 133	0	0	0	0
RRISL 210	0	0	0	0
PB 235	0	0	0	0
RRISL 2001	0	0	0	0
RRIM 717	0	0	0	0
GPS 1	1	1	1	1
RRISL 212	0	0	0	0

Clone	Average disease severity score			Mean ADSI
	Year 2014	Year 2015	Year 2016	
RRISL 202	3	2	3	2.66
RRISL 2004	0	0	0	0
RRISL 2005	1	0	1	0.66
RRISL 217	2	1	2	1.66
RRISL 205	0	0	0	0
RRISL 2002	1	0	1	0.66
RRIC 131	2	1	1	1.33
RRISL 203	0	0	0	0
RRISL 223	2	2	2	2
RRISL 201	2	1	2	1.66
RRISL 222	3	2	3	2.66
RRISL 215	0	0	0	0
RRISL 218	1	1	2	1.33
RRISL 220	1	1	2	1.33
RRIC 102	0	0	0	0
RRISL 221	0	0	0	0
RRISL 226	0	0	0	0
RRIC 130	0	0	0	0
RRISL 214	0	0	0	0
RRISL 2000	1	1	1	1
PB 260	0	0	0	0
PR 305	1	0	1	0.66
RRISL 2003	0	0	1	0.33
BPM 24	0	0	0	0
RRISL 207	1	0	1	0.66
RRISL 204	0	0	0	0
RRIC 121	0	0	0	0.66
IAN 717	1	0	1	0.66
PB 28/59	0	0	0	0
RRISL 216	0	0	0	0
RRIC 100	0	0	0	0
RRISL 225	1	0	1	0.66
RRII 105	3	2	2	2.33
PR 255	0	0	0	0
RRISL 227	3	3	3	3
RRIC 110	4	4	4	4

Average disease severity score:
0 - No CLFD infection
1 - <25% of the canopy infected
2 - 25-50% of the canopy infected
3 - 50-75% of the canopy infected
4 - >75% of the canopy infected

Table 2. *Disease severity of the clones grown in Sri Lankan rubber plantations evaluated under natural field conditions*

Clone	Average disease severity score			Mean ADSI	Clone	Average disease severity score			Mean ADSI
	Year 2014	Year 2015	Year 2016			Year 2014	Year 2015	Year 2016	
RRIC 100	0	0	0	0	RRISL 208	1.25	1	1	1.08
RRIC 102	0	0	0	0	RRISL 218	0	0	0	0
RRIC 121	0	0	0	0	RRISL 220	0	0	0	0
RRIC 130	0	0	0	0	RRISL 221	0	0	0	0
PB 217	0	0	0	0	RRISL 222	0	0	0	0
PB 28/59	0	0	0	0	RRISL 226	0	0	0	0
RRIC 117	0	0	0	0	GPS 1	0	0	0	0
RRIC 133	0.67	0.67	0.67	0.67	PB 255	0	0	0	0
RRISL 201	2	2	2	2	PR 255	0	0	0	0
RRISL 202	2.5	2.25	2.67	2.47	RRII 105	0	0	0.67	0
RRISL 203	0	0	0	0	RRISL 2001	0	0	0	0
RRISL 205	0	0	0	0	RRISL 2003	0	0	0	0
RRISL 206	0	0	0	0	RRISL 2000	0	0	0	0
RRISL 211	0	0	0	0	RRISL 2002	0	0	0	0
RRISL 215	0	0	0	0	RRISL 2004	0	0	0	0
RRISL 217	0.5	0.5	0.5	0.5	RRISL 2005	0	0	0	0
PB 235	0	0	0	0	RRISL 2006	0	0	0	0
PB 260	0	0	0	0	Cent 2	0	0	0	0
MPB 240	0	0	0	0	Cent 3	1	1	1	1

Clone	Average disease severity score			Mean ADSI
	Year 2014	Year 2015	Year 2016	
RRISL 200	3.5	3.5	3	3
RRISL 204	0	0	0	0
Cent 4	0	0	0	0
Cent 5	0	0	0	0

ADSI value:
0 – no CLFD lesions,
1 – Mild infection (<25% canopy shows Corynespora lesions)
2 – Moderate infection (25 – 50% canopy shows Corynespora lesions)
3 – Severe infection (50 – 75% canopy shows Corynespora lesions)
4 – Very severe infection (>75% canopy shows Corynespora lesions) with leaf fall

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